Citation:

Mrdjenovic G, Levitsky DA. Nutritional and energetic consequences of sweetened drink consumption in 6- to 13-year-old children. *J Pediatr* 2003;142:604-10.

PubMed ID: 12838186

Study Design:

Longitudinal Cohort (or nonrandomized trial using own subjects as controls?)

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

NEUTRAL: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To study the effects of excessive sweetened drink consumption on daily energy balance and nutrient intakes in a longitudinal study of children.

Inclusion Criteria:

Not specified but stated that all were 'healthy'

Exclusion Criteria:

Children with poor dietary recording (those not included did not differ 'on any measure' from those who completed the study) [number not specified; 12 (42 – 30)? Or 9 (30 – 21)?; measures not specified]

Description of Study Protocol:

- 4-8 week Cornell Summer Day Camp in 1997
- After 1st week of camp, all food and beverages consumed during the week were provided (dinners sent home) and amount eaten weighed; Parents were responsible for returning uneaten dinner + recording additional foods eaten during week as well as food provided by parents on weekends (using standard home measures)
- Note: not clear if same foods were provided every day or varied menus or how often sweetened beverages were 'served' vs 'offered'
- Unlimited access to water, 2% milk, fruit-flavored sweetened beverages at camp; no vending machines with soft drinks
- 100% fruit juice provided at breakfast and some lunches, skim milk (or 2% if not like skim) at breakfast, morning snack, lunch & upon request
- Height and weight taken in am before breakfast during 1st and last week of camp

Data Collection Summary:

(not blinded)

Dependent

Daily intake of:

- Solid food (g)
- Energy
- Protein
- Minerals – Ca, Mg, P, Zn
- Vitamins – A, C, folate, riboflavin

Anthropometry:

- Body weight
- BMI

Independent

Daily beverage intake as categorical variable: 0 (none); 1 (≤6 oz); 2 (6-12 oz); 3(12-16 oz), 4 (>16 oz) (Note: gram/serving size description not clear):

- Sweetened beverage intake (soda, <100% fruit juice, Kool-Aid, fruit punch, Snapple, etc.)
- Milk (fluid milk, milk shakes)
- 100% fruit juice

Control variables

- age, gender, energy intake, amount served (amount put on serving tray by investigators) [Note: say these used to determine whether sweetened beverage consumption displaced milk; does not say if used for body wt analyses]

Statistics

- Randomized block design for repeated measures (each child = a 'block')
- ANOVA
- Multiple linear regression
- To control for both between- & within-subject error & multi-colinearity of data, PROC MIXED used in SAS (?)

Description of Actual Data Sample:

Initial N: 30 (selected from a group of 42)

Final N: 21 (70% f/u)

Age: 6-13 y

Ethnicity: most white; 5 minorities

SES: most upper-middle class

Note: no explanation of why 9 children lost to follow-up

Summary of Results:

Milk intake

- Drank significantly less milk (247 ± 17 g/d) on days consumed >16 oz sweetened drinks than when did not have any (368 ± 14 g/d milk) (P <.0001) (trend observed for every child) – even after adjusting for being served less milk when sweetened drinks were available in excessive amounts
- Drank significantly less milk when large amount of 100% fruit juice consumed – even after adjusting for amount milk served

Solid food

- No effect (p = .03) of sweetened beverages – even after adjusted for amount solid food served
- No effect (p=.37) of fruit juice

Energy intake

- Higher (244 kcal/d more) when sweetened drinks consumed than when they were not (P=.0001). After adjusting for total amt of food and drinks served, total daily energy intake remained relatively constant across all levels of sweetened drink consumption (P=.22) indicating that any observed increase in daily energy intake was result of higher amt of sweetened drinks consumed.
- "Children at highest (sweetened) beverage category had highest daily energy intake, 91% ± 5% RDA. Children at lowest sweetened beverage category achieved 82% ± 5% RDA for energy" (no p value given)
- No discussion of effect of fruit juice

Anthropometry

- Initial body wt negatively associated with sweetened drink (-.43 kg/glass, p<.0001) [no mention of relation with BMI]
- Initial body weight negatively associated with fruit juice (p = .003); no significant relation with BMI (P=.08)
- 'Children at highest level of sweetened drink intake (>16 oz/d) gained more weight during study (1.12 ± 0.7 kg) than those who consumed 6-16 oz/d (0.32-0.48 ± 0.4 kg); but not statistically significant (P=.4) given small sample size'
- 'Similar trends in weight gain, just stronger, with excess fruit juice. Children consuming >12 oz/day gained 3.3 kg ± 1.95 kg, whereas those with <6 oz/d gained 0.5 kg ± 0.4 kg (p = .2)'

Nutrient Intake

- Excess sweetened drink consumption (>12 oz/d) vs minimal (<6 oz/d) associated with adjusted (not sure what adjusted for) lower mean daily intakes of protein, Ca, Mg, P, Zn, and vitamin A intakes (P <.0001) and higher vitamin C intake (P <.0001)
- No effect on folate or riboflavin

Results presented in Table III

Author Conclusion:

Excessive sweetened drink consumption is associated with the displacement of milk from children's diets, higher daily energy intake, and greater weight gain. Hence, excessive sweetened drink consumption associated with decreased milk intake may be an important risk factor for childhood obesity and poor nutrition.

Reviewer Comments:

***Weaknesses**:*

- *Not clear how long camp was on average; short time period*
- *Not clear why final sample size less than initial or if those that were not included in analyses were different than others*
- *Not clear about control variables in wt/BMI analysis*
- *Referred to things being different when not significantly so*
- *No discussion of relation of fruit juice & BMI*
- *Conclusions not justified from results*

Strengths:

- *Weighed food intake for weekdays*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions

1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	N/A
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	N/A

Validity Questions

1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes

1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	No
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	No
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes
2.4.	Were the subjects/patients a representative sample of the relevant population?	???
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	N/A
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	Yes
4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	N/A

4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	N/A
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	Yes
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	No
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	No
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	???
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	Yes
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	No
6.6.	Were extra or unplanned treatments described?	No
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	???
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes

	7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
	7.6.	Were other factors accounted for (measured) that could affect outcomes?	No
	7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**		Yes
	8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
	8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
	8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
	8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
	8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	No
	8.6.	Was clinical significance as well as statistical significance reported?	Yes
	8.7.	If negative findings, was a power calculation reported to address type 2 error?	No
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**		No
	9.1.	Is there a discussion of findings?	Yes
	9.2.	Are biases and study limitations identified and discussed?	No
10.	**Is bias due to study's funding or sponsorship unlikely?**		Yes
	10.1.	Were sources of funding and investigators' affiliations described?	Yes
	10.2.	Was the study free from apparent conflict of interest?	???